IN THE TITLE OF THE INVENTION

Please amend the Title to read as follows:

-- THERMOELECTRIC CONVERTER HAVING HIGH TEMPERATURE SIDE PREAMBLE ELECTRODE --

IN THE SPECIFICATION:

Please amend the following paragraphs as follows.

[0010] Some power generation devices utilizing this power generation principle have been reported. FIG. 10 shows a conventional power generation device. A solid electrolyte 201 such as β" alumina is provided in a container 207, ~~an anode~~ a cathode side of the solid electrolyte 201 contacts with a porous electrode 203, and ~~a cathode~~ an anode side thereof contacts with sodium 202 serving as an operating medium. A load 206 is connected between the ~~anode~~ cathode side electrode and the ~~cathode~~ anode side electrode. An upper side portion of sodium 202 in FIG. 10 is heated by a high-temperature heat source 208, and the lower side portion is cooled by a low-temperature heat source (not shown in FIG. 10). At the lower side of FIG. 10, an electromagnetic pump 210 is provided, and sodium condensed with a condenser 209 is fed from the right side to the left side of FIG. 10 under pressure.

[0011] In this power generation device, sodium atoms supplied at the left side (~~cathode~~ anode side) of the interface of the solid electrolyte 201 emit electrons and are ionized. The ionized sodium atoms move to the porous electrode 203 in the solid electrolyte 201, and accept electrons to be reduced at the porous electrode 203. Then, the sodium atoms absorb heat from the high-temperature heat source 208 and evaporate. Gas-phase sodium is returned to liquid-phase sodium with the condenser 209, and then supplied to the solid electrolyte 201 in a liquid phase by the electromagnetic pump 210. The electrons emitted at the cathode side of the solid electrolyte 201 pass through the load 206 to the porous electrode 203, and bind to sodium ions as described above.

[0022] The inventors carried out experiments with a power generation device shown in FIG. 1(a) and found that substantially the same electromotive force as achieved when power is generated by using a pressure difference can be achieved without generating any pressure difference between ~~anode~~ cathode and ~~cathode~~ anode sides of solid electrolyte. In FIG. 1(a), 1 represents a β" alumina tube, 2 represents sodium serving as an operating medium, 3 represents a molybdenum electrode for conducting sodium reduction, 4 represents an α alumina tube, 5 represents a heater, 6 represents a potentio-galvanostat for conducting current-voltage measurement, and 7 represents a container. In this power generation device, the inside of the container was evacuated, and power generation was conducted under conditions that the molybdenum electrode 3 was kept at 712°C and the sodium 2 was kept at 351°C. At this time, a current-voltage characteristic shown in FIG. 1(b) could be obtained.

[0023] ~~Concequently~~ Consequently, according to the present invention, heat energy can be directly converted into electrical energy without using the pressure difference. Therefore, according to the present invention, an effect of utilizing no pressure difference, that is, facilitation of a manufacturing and simplification and reduction in cost of the device can be achieved with keeping the advantage of the thermoelectric converter described above. Furthermore, durability of the device is increased, and no problem occurs even when solid electrolyte is broken.

[0035] FIG. 2(a) is a cross-sectional view showing a first embodiment of the present invention. In FIG. 2(a), 101 represents a solid electrolyte comprising β" alumina, 102 represents sodium serving as an operating medium, 103 represents a porous electrode which emits electrons to reduce sodium ions, each of 104 and 105 represents a bush comprising an insulating material, 106 represents a load, 107 represents a container creating a hermetic space, 108 represents ~~an anode~~ a cathode terminal, and 109 represents ~~a cathode~~ an anode terminal. The inside of the container 107 is evacuated.

[0036] As shown in FIG. 2(a), in the thermoelectric converter, when the load is connected between the ~~anode~~ cathode and ~~cathode~~ anode terminals and the porous electrode 103 side of the solid electrolyte 101 is heated while the sodium 102 side is cooled, electric power can be generated and supplied to the load. FIG. 2(b) is a cross-sectional view showing the power generation principle. In the thermoelectric converter, at the low-temperature side, the following reaction proceeds at the interface between the solid electrolyte 101 and the sodium 102.

$$Na \rightarrow Na^{+} + e^{-}$$

Electrons are emitted through the sodium 102 to the anode terminal 109, and sodium ions are supplied to the solid electrolyte 101. At the high-temperature side of the solid electrolyte 101, electrons are supplied through the ~~anode~~ cathode terminal 108 to the porous electrode 103, and the following reaction proceeds at the interface between the solid electrolyte 101 and the porous electrode 103, and sodium is generated.

$$Na^{+} + e^{-} \rightarrow Na$$

[0038] According to this embodiment, since the porous electrode 103 and the upper container 107a are connected to each other by the connecting conductor 110, the heat transfer efficiency from the outside to the inside is enhanced. Furthermore, since the high-temperature side and the low-temperature side are separated from each other by the insulating member 111, the thermal efficiency can be enhanced. In addition, the upper container 107a and the lower container 107b may be directly used as ~~an anode~~ a cathode terminal and ~~a cathode~~ an anode terminal, respectively.

[0041] FIG. 5 is a cross-sectional view showing a fourth embodiment of the present invention. In FIG. 5, the same portions as the first embodiment shown in FIG. 2(a) are represented by the same reference numerals, and duplicated description thereof is omitted. In this embodiment, liquid-phase sodium is used by being impregnated in a sponge metal. That is, sodium condensed in the low-temperature portion is impregnated in the sponge metal, and a sodium-impregnated sponge metal 112 is connected to the ~~cathode~~ anode terminal 109. A wick-like metal may be used in place of the sponge metal.

[0043] FIG. 6 is a cross-sectional view showing a fifth embodiment of the present invention. In FIG. 6, the same portions as the first embodiment shown in FIG. 2(a) are represented by the same reference numerals, and duplicated description thereof is omitted. In this embodiment, a cooling member 113 serving as a sodium condensing portion is disposed at the upper portion of the container 107, and the lower portion of the container is heated. The solid electrolyte 101 is set in an inverted arrangement with respect to the other embodiments, and a depressed portion 101a serving as a liquid reservoir is disposed at the upper portion of the solid electrolyte 101. The cooling member 113 is designed to have such a shape that condensed sodium is guided to the depressed portion 101a serving as the liquid reservoir. In this embodiment, plural cells are serially connected at plural stages. That is, the ~~cathode~~ anode terminal 109 is connected to the sodium 102 at the first-stage cell, and the porous electrode 103 of the first-stage cell is connected to the sodium 102 at the second-stage cell. The same connection as described above is successively carried out on the subsequent stages, and the porous electrode 103 of the final-stage cell (third-stage cell in the case of FIG. 6) is connected to the ~~anode~~ cathode terminal 108.

[0047] FIG. 8 is a cross-sectional view showing a seventh embodiment of the present invention. In FIG. 8, the same portions as the first embodiment shown in FIG. 2(a) are represented by the same reference numerals, and duplicated description thereof is omitted. In this embodiment, β" alumina is not used, but only a molten salt 114 is used as the ion-conductive material. In place of a porous electrode, an electrode mesh 103a comprising a metal material is used. That is, in this embodiment, the molten salt 114 serving as the electrolyte material contacts with the electrode mesh 103a at ~~an anode~~ a cathode terminal 108 side at the high-temperature side, and contacts with liquid-phase sodium 102 at ~~a cathode~~ an anode terminal 109 side at the low-temperature side. The characteristic of the molten salt 114 required in this embodiment is same as that of the sixth embodiment, that is, the sodium ion conductivity is high, the melting point is low, the vapor pressure even at high temperature is low so that the molten salt 114 is hardly decomposed.

[0049] FIG. 9 is a cross-sectional view showing an eighth embodiment of the present invention. In FIG. 9, the same portions as the first embodiment shown in FIG. 2(a) are represented by the same reference numerals, and duplicated description thereof is omitted. In this embodiment, a condensing portion 116 is provided separately from a reaction portion of an operating medium in the container 107, and ~~an anode~~ a cathode side and ~~a cathode~~ an anode side of the solid electrolyte 101 and a node space are separated from one another by a partition plate 115. In this power generation device, when the ~~anode~~ cathode side of the solid electrolyte 101 is heated while the ~~cathode~~ anode side thereof is cooled (T2>T1), and also the temperature T3 of the condensing portion 116 is set to be lower than the temperature T1 of the ~~cathode~~ anode side of the solid electrolyte 101 (T1>T3), a difference between the vapor pressures P1 and P3 of sodium

in the respective portions generates (P1>P3), so that the liquid surface at the condensing portion side of the sodium 102 is higher than that at the ~~cathode~~ anode side by h. That is, a slight pressure difference occurs between the ~~anode~~ cathode and ~~cathode~~ anode sides of the solid electrolyte 101 due to the difference between the vapor pressures. Although the pressure difference is small, the ion conductivity of the solid electrolyte can be enhanced by setting T3 to a small value with keeping the vapor pressure P3 to a small value to keep the electromotive force, and setting T1 to a high value.